ABSTRACT

Rengali Province occupies a unique geographical position between the Archean Singhbhum Craton and the Proterozoic Eastern Ghats Belt of eastern India. This province was variably considered a part of the Singhbhum Craton and/or the Eastern Ghats Belt, but their metamorphic characters are grossly contrasting. This opens a possibility that the Rengali Province evolved as a separate orogenic belt that may be unrelated to the Eastern Ghats Belt. The most striking feature of this province is the occurrence of several linear WNW-ESE trending zones separated by major ductile faults or shear zones. The rocks of this province show varying degree of metamorphism from granulite to greenschist facies. Geological mapping of the central part of the Rengali Province reveals presence of a gneissic basement block intercalated with low-grade supracrustal sequences. The basement rocks are mostly of granitoid composition showing gneissic fabric and the rocks are metamorphosed to amphibolite facies. Enclaves of granulite facies rocks, represented by charnockite gneiss and mafic granulite, occur within the gneissic basement. A part of this gneiss basement, referred to here as the Central Gneissic Belt, is the prime focus of petrological, geochemical and geochronological study. Supracrustal rocks are represented by quartzite, mica schist and calc-silicate schist that belong to the Tikra Association.

Detailed structural analyses of the rocks from the central part of Rengali Province suggest that deformation was regionally partitioned into fold-thrust dominated shortening zones alternating with zones of dominant transcurrent deformation bounded between the Barkot Shear Zone in the north and the dextral Kerajang Fault Zone in the south. The strain partitioned zones are further restricted between two regional transverse shear zones, the sinistral Riamol Shear Zone in the west and the dextral Akul Fault Zone in the east. The overall structural disposition can be interpreted as a positive flower structure bounded between the longitudinal and transverse faults with vertical extrusion and symmetric

juxtaposition of mid-crustal amphibolite grade basement gneisses over low-grade upper crustal rocks emanating from the central axis of the transpressional belt.

. The Central Gneissic Belt is constituted of charnockite gneiss, migmatitic hornblende gneiss and felsic gneiss often showing gradational contacts. While mafic granulite occurs as enclave within the charnockite gneiss, amphibolite and calc-silicate granofels enclaves are present within the felsic gneiss. Petrological study shows that the charnockites and mafic granulites underwent granulite facies metamorphism, whereas the gneisses were subjected to amphibolite facies metamorphism. Mafic granulite shows peak metamorphic assemblage of garnet + clinopyroxene + plagioclase + quartz ± orthopyroxene which was stabilized at 10.6 ± 0.5 kbar and 860 ± 20 °C. Charnockite gneiss with the peak assemblage of orthopyroxene +quartz + plagioclase +K-feldspar was metamorphosed at 792 ± 48°C and 7.6 ± 0.4 kbar. Amphibolite and migmatitic hornblende gneiss contain hornblende along with plagioclase and garnet and these rocks were metamorphosed at 800 ± 20 °C, 8.5 ± 0.2 kbar and 695 °C, 8 kbar respectively. Later meta-dolerite dikes exhibit relic igneous textures which are slightly modified by greenschist facies metamorphism. Charnockite gneiss, migmatitic hornblende gneiss and felsic gneiss show similar trace and REE characteristics (moderate fractionation in terms of La and Yb, LREE enrichment and flat HREE pattern) implying the same protolith composition for these rock groups. Field, petrographic and geochemical data suggest that the protoliths for the charnockite gneiss, the migmatitic hornblende gneiss and the felsic gneiss crystallized as fractionated magma in within-plate syncollisional setting during a prominent phase of orogeny at the Rengali Province.

Results of detailed zircon U–Pb (SHRIMP) geochronological study of the amphibolite to granulite facies rocks of the Central Gneissic Belt reveal a complex evolutionary history. Charnockitic gneiss has protolith age of 2861 ± 30 Ma and high-grade metamorphism occurred at 2818 ± 15 Ma. Migmatitic hornblende gneiss has a protolith age of 2828 ± 9 Ma.

The leucogranite was emplaced at 2807 ± 13 Ma. The protolith of the felsic gneiss was emplaced at 2776 ± 24 Ma. Most of the zircon samples contain overgrowths of c. 2500 Ma, inferred to be the age of reworking of the Central Gneissic Belt. These data suggest that the Rengali Province evolved as an orogenic belt in the Neoarchean time (ca. 2800–2500 Ma) during southward growth of the Singhbhum Craton. These tectonothermal imprints at the margin of the Singhbhum Craton are possibly related to its inclusion within the supercontinent Ur. Interestingly, the rocks of the Central Gneissic Belt and the associated supracrustals do not record any age signatures of ca. 1000-900 Ma orogeny that evolved the Eastern Ghats Province, thus discarding any genetic link between the two adjacent orogenic belts. The later transpression, extrusion and juxtaposition of deep crustal section to shallower level was achieved due to reactivation of the fault-thrust system during ca. 530-500 Ma which can be linked to far field stresses of global Pan-African orogeny.

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